

History of systematic mycology in Australia

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Abstract

The history of systematic mycology in Australia revolves around the contribution of Daniel McAlpine. Prior to McAlpine's appointment in 1890 to the Victorian Department of Agriculture almost all collections of Australian fungi had been sent to and named by mycologists at Kew. McAlpine established the first mycological herbarium in Australia between 1890 and 1911, and described 320 new species and six new genera, mostly of pathogenic fungi. After McAlpine, systematic mycology was largely neglected, apart from work on the larger fungi by J. B. Cleland in the 1930s, until a few plant pathologists beginning in the 1950s and 1960s revived the study of fungal taxonomy. The majority of mycological specimens today are lodged in about six herbaria, but only half of these have active taxonomists/curators. There are fewer than ten full-time fungal taxonomists working in Australia. The reasons for this neglect of fungal taxonomy are discussed in the light of economic importance and the numbers of fungi relative to other plant groups.

The history of systematic mycology in Australia can be conveniently divided into four eras, largely circumscribed by the contribution of one man, Daniel McAlpine, as follows:

- 1770–1890: pre-McAlpine era
- 1890–1916: McAlpine era
- 1916–1960: post McAlpine era
- 1960 onwards: present era

The pre-McAlpine era was a period of very little mycological activity in Australia, and most collections of fungi were sent by botanical collectors to European (mostly British) mycologists. By 1895 (McAlpine 1895a) about 2,000 fungi had been recorded from Australia. The pre-McAlpine era is discussed in detail by Parbery & Sheather (this volume) and May (this volume) has discussed the history of the taxonomy of Australian Agaricales. My discussion is limited to the period after 1890, and concentrates on microfungi in the context of plant pathology, with only occasional references where appropriate to other groups of fungi.

The appointment in 1890 of Daniel McAlpine as Consulting Vegetable Pathologist to the Victorian Department of Agriculture was due more to phytopathological necessity than to an appreciation of the need for increased taxonomic activity. Severe epidemics of rust in wheat in the 1860s had led to the establishment of a committee chaired by Ferdinand Mueller to enquire into the effects of agricultural practices on the severity of the disease. This committee recommended early sowing and careful selection of wheat varieties as a means of control. Another severe epidemic of rust in 1889 was followed by the first national Rust-in-Wheat conference in 1890. This conference recommended an accelerated programme of experimental work and almost certainly led to the appointment of Daniel McAlpine in May 1890 (Fish 1976).

Daniel McAlpine

McAlpine was born at Saltcoats, Ayreshire, Scotland on 21 January 1849 and studied science at the Royal School of Mines, South Kensington under Thomas Huxley. He married in 1878 and after having lectured in biology and botany for eight years in Edinburgh travelled to Melbourne where he arrived in 1884. In 1885 he was appointed as Lecturer in Botany and Biology at Ormond College, University of Melbourne and as Lecturer in Botany at the College of Pharmacy in 1886, the latter position being held until 1911. On 12 May 1890 he was appointed Consulting Vegetable Pathologist to the Department of Agriculture, Victoria, at a salary of £200 p.a. with instructions to inquire into 'matters appertaining to Rust in wheat' and 'other matters which may form subjects of enquiry' (letter of appointment on display at PRI, Burnley).

He immediately embarked on an ambitious programme of experimental work, establishing trials on wheat in all parts of the state, with the co-operation of farmers and departmental staff. However, he held a very strong view that experimental work on a disease must not be carried out in isolation from an understanding of the taxonomy of the causal organism and its relatives. Consequently he held that it was necessary to study not only the wheat rust organism (*Puccinia graminis*) but all rusts on all Australian plants and he extended this philosophy to all groups of fungi with which he dealt. Taxonomically he commenced with the preparation of his *Systematic arrangement of Australia fungi* (McAlpine 1895a) in which he listed 2,284 species of fungi. During the next 20 years he was to add over 320 new species and six new genera to this list as well as numerous new records. The first new species described by him was *Laccocephalum basila-piloides* McAlp. & Tepper, a stipitate polypore arising from a large subterranean sclerotium. Thereafter he concentrated his taxonomic efforts almost exclusively

on plant pathogenic microfungi, publishing 226 papers, (mostly in Australian journals), numerous annual reports, and six books (McAlpine 1910). *The rusts of Australia* (1906) and *The smuts of Australia* (1911) are his best known and most influential books and remain standard works on their respective subjects today. In the former publication McAlpine increased the number of known rusts from 72 known in 1892 (Cooke 1892) to 161, of which 75 were new species described by him. The latter work contained his descriptions of 26 new smuts, bringing the number known for Australia to 68. He also published on diseases of citrus, stone fruits, potatoes, vines, vegetables, apples and pears, as well as numerous papers on fungi from native plants. His herbarium, containing over 9,000 specimens, including his types and a large collection of valuable exsiccatae, is housed in the Plant Research Institute, Burnley (VPRI).

In 1911 McAlpine was seconded by the combined State and Commonwealth Governments to investigate the nature and control of bitter pit of Apples, a storage disorder which was having a serious effect on Australia's export trade in apples. He undertook the work reluctantly, perhaps because he quickly realized that it was of non-pathogenic origin, and was taking him away from other work that he had planned, including a text book on plant diseases in Australia. Nevertheless he undertook an exhaustive investigation of the anatomy and physiology of the apple fruit and published five annual reports up to 1916. He was unsuccessful in finding a solution to the problem. When the funding expired in 1916 he discovered that his old position as Vegetable Pathologist had been given to his former assistant C. C. Brittlebank in 1913, so that McAlpine was in effect unemployed. This upset him greatly and he never returned to taxonomic mycology, instead continuing his private research into bitter pit in collaboration with overseas pathologists. [The causal relationship between calcium deficiency and bitter pit was not implicated until 1936 (De Long 1936) and not generally accepted until the early 60s (Baxter 1962).]

Daniel McAlpine and his wife Isabella retired to a country property at Wandin, east of Melbourne, which they later sold in 1924 in order to live with their five daughters and their respective families. McAlpine died on 12 October 1932 at his daughter Constance McDougall's home at Leitchville and is buried in Cohuna cemetery. Various memorabilia of McAlpine, including photos and biographical notes by his daughter Erica Wedge, are housed in the Plant Sciences Library at Burnley, while much McAlpine correspondence is in the Latrobe Library, Melbourne, and correspondence from William Farrer is in the Mitchell Library, Sydney. A detailed biography was published by Fish (1976). McAlpine is recognized as the father of both plant pathology and taxonomic mycology in Australia and the biennial conferences of the Australian Plant Pathology Society always include a 'Daniel McAlpine Memorial Lecture'.

Other significant contributors to Australian mycology during the McAlpine era were: Nathan Cobb, plant pathologist to the N.S.W. Department of Agriculture from 1890–1905, who published a number of papers on fungi but was best known as a nematologist; L. Rodway, Tasmanian Government Botanist who

described several new fungal species between 1890 and 1920; and L. H. Bailey the Queensland botanist who published many papers on fungi.

McAlpine was also ably supported by energetic collectors, including his assistants G. H. Robinson and C. C. Brittlebank, and F. M. Reader of Dimboola.

Post-McAlpine era

The major figures in fungal taxonomy in the period 1916–1960 are listed in Table I. Charles Clifton Brittlebank was McAlpine's immediate successor, but he did not have a major interest in taxonomy, publishing only a few names. Brittlebank's chief concern was the establishment of a viable plant pathology laboratory which eventually became the Plant Research Laboratory at Burnley in 1929 (now the Plant Research Institute). His most significant contribution was a checklist of Australian fungi and their hosts completed in 1940 and given limited distribution. Brittlebank and his successors in the Victorian Department of Agriculture apparently no longer acknowledged the necessity for plant pathology to be supported by fungal taxonomy, possibly in the belief that McAlpine's work had laid a sufficiently solid foundation and that overseas experts could provide any additional support required. It is probably also true that the pressing need for solutions to problems of disease control made taxonomy appear a luxury. Consequently, apart from the few fungi described by Brittlebank and one fungus (*Venturia carpophila*) described by E. E. Fisher (1961), the subsequent fifty years yielded little in the way of taxonomic work from the Victorian Department of Agriculture. Very few specimens, most notably collections of common plant pathogens by A. T. Pugsley, were added to McAlpine's herbarium.

Ethel McLennan was appointed to the School of Botany, University of Melbourne in 1915 and lectured in Mycology and Plant Pathology until her retirement in 1955. Although best known as a plant pathologist and teacher, she published several important taxonomic papers, mostly on non-pathogenic fungi, primarily Clavariaceae (McLennan 1932) and Tuberales (McLennan 1961). Her specimens are held in the herbarium of the Botany School, University of Melbourne (MELU). Her paper on Clavariaceae was followed by two papers by S. G. M. Fawcett (1937, 1939) who described additional species.

Edwin Cheel and John Burton Cleland published together on agarics in New South Wales during the early 1930s and their New South Wales specimens are held in the Rydalmere herbarium (DAR). Later Cleland moved to South Australia, where in 1934 he published his *Mushrooms, toadstools and other larger*

Table I
Major figures in taxonomic mycology, 1916–1960

Name	State	Herbarium
Brittlebank	Vic.	VPRI, CANB
McLennan	Vic.	MELU
Cheel	N.S.W.	DAR, NSW
Cleland	S.A., N.S.W.	AD, DAR
Fawcett	Vic.	MELU
Hansford	S.A.	ADW
Cunningham (G. H.)	Vic., N.S.W. (N.Z.)	MELU, PDD
Walters	Vic.	'CSIRO-Hightt'
Willis	Vic.	MEL

fungi of South Australia. His South Australian specimens are held in the State Herbarium of South Australia (AD). Cleland's collections have recently been extensively re-examined by Cheryl Grgvinovic with a view to publication of a revised edition of Cleland's handbook.

C. G. Hansford was head of the Plant Pathology Department at the Waite Agricultural Research Institute (ADW) from 1951–1958 and during this time concentrated on the taxonomy of fungi, especially Meliolaceae, from Australian plants. He described about 400 species, including 145 new species and two new genera and made 19 new combinations. Hansford's papers and his herbarium at ADW remain essential source material for anyone working on fungi on Australian plants. Use of the herbarium is especially necessary since, although Hansford's published descriptions are excellent, he seldom published illustrations. There is no longer a fungal taxonomist at ADW and the long-term preservation of Hansford's specimens is cause for considerable concern.

Another significant contributor to knowledge of Australian fungi was the New Zealand mycologist G. H. Cunningham, whose many publications on New Zealand fungi often included Australian records. His *Thelephoraceae of Australia and New Zealand* (1963) is especially significant in this respect. Most of his large herbarium is in Auckland (PDD), although some Australian collections are in MELU. The Victorian mycologist N. E. M. Walters amassed a large collection of wood rotting fungi, mostly Aphyllophorales, and his specimens and cultures are held at the CSIRO Division of Building Research in Highett, Victoria. Unfortunately there is no taxonomist at this herbarium now and the future of the collection, especially the culture collection, is in doubt. James H. Willis, the well-known Victorian botanist, collected larger fungi over many years and published a number of papers in the *Victorian Naturalist* and a field guide to toadstools and mushrooms (Willis 1957). His collections are at the National Herbarium of Victoria (MEL).

Numerous other plant pathologists and botanists collected and published on fungi during the post-McAlpine period but there were very few professional, full-time fungal taxonomists in the country who made a significant contribution to our knowledge of Australian fungi. The exceptions are J. B. Cleland, G. H. Cunningham and C. G. Hansford. There are of course scattered references to Australian fungi published by overseas taxonomists but these contributions are outside the scope of this paper.

The present

I have dated the present period from 1960, partly because most taxonomists still active started to contribute to Australian taxonomy after 1960, and partly because John Walker began his taxonomic work in the early 1960s. Walker has been the major influence on fungal taxonomic work in Australia for more than 20 years, especially in terms of the organisation of mycological work and as a stimulatory influence on many individuals with an interest in taxonomy. He has built up DAR into the most important fungal collection in the country, and been instrumental in gaining recognition by the Standing Committee on Agriculture of the three major mycological herbaria (DAR, VPRI, BRIP) as the National Collection of Fungi.

In 1980 Walker produced a list of mycological herbaria and culture collections in Australasia (Walker 1980a). Table II is a list of the most important herbaria from that list containing 70% of fungal specimens held in Australian herbaria, updated where appropriate to the present day. The most remarkable point to be made from this list is that, of the eight herbaria listed, only three have active taxonomists associated with them and only four are actively curated. All of those with taxonomists are Department of Agriculture (or Primary Industries in Queensland) institutions dedicated to plant pathology research. The other actively curated collection is MELU which although only a small collection contains material from a number of important collectors and is currently accessioning the collections of H. J. Swart and G. Beaton.

Taxonomic activity in DAR, BRIP and VPRI arose because individuals, originally appointed as plant pathologists, developed an interest in fungal taxonomy and persisted (in some cases against considerable opposition) until taxonomy and herbarium curation became their accepted roles. Michael J. Priest, appointed to DAR in 1982 is perhaps the only mycologist in Australia appointed specifically as a taxonomist. John Walker has published in a wide range of taxonomic groups but a major contribution has been in unravelling the complicated taxonomy and nomenclature of the cereal take-all fungus *Gaeumannomyces graminis* and its relatives (Walker 1980b), work that has had worldwide acceptance. John Alcorn, at BRIP, has published mostly on *Drechslera* and its segregates, with a major paper (1983) on generic delineation in the group. My own interests are in *Fusarium* taxonomy and in the taxonomy of fungi on native plants. All three herbaria concentrate on plant pathogenic micro-fungi, but in keeping with their joint role as the

Table II
Principal mycological (non-lichen) herbaria in Australia

Herbarium	Locality	Specimens	Collectors	Taxonomists	Curated
AD	Adelaide, S.A.	9,000	Cleland	0	
ADW	Glen Osmond, S.A.	16,500	Hansford	0	
BRIP	Indooroopilly, Qld.	17,000	Alcorn, Langdon, Bailey, Simmonds	1	*
DAR	Rydalmere, N.S.W.	74,000	Walker, Fraser	2	*
MEL	S. Yarra, Vic.	18,500	Willis	0	
MELU	Parkville, Vic.	2,500	Swart, McLennan, Beaton, Fawcett	0	*
VPRI	Burnley, Vic.	16,000	McAlpine, Sutton, Pascoe	1	*
'CSIRO'	Highett, Vic.	9,000	Walters	0	

* Collections which are actively curated at present.

National Collection of Fungi, hold specimens from all groups of fungi, whether economically important or not.

In all of these agriculture-orientated herbaria the role of the taxonomist/curator embraces diagnosis and identification services, for both scientists and the general public, curation and loan administration of herbarium specimens and culture collections, provision of plant disease checklist data for quarantine and trade authorities, provision of advice to a range of individuals on the biology, pathology and distribution of fungi, and on techniques of culture and microscopy for plant pathologists. Taxonomic research invariably is relegated to a spare-time activity and the publication rate of these individuals is not as high as might be expected if taxonomic research was their principal activity.

The only herbaria associated with botanic gardens, and with substantial mycological collections, are AD and MEL. Neither has a mycologist on staff and no other state herbarium in Australia has a mycologist. AD contains the important Cleland collection of large basidiomycetes. MEL contains the second largest mycological collection in Australia but it has never been curated or catalogued and the large collection of exsiccatae is virtually inaccessible due simply to the impossibility of knowing what is there or how to find it. Willis's collections of basidiomycetes are similarly unsorted and uncatalogued. The collection has been static for decades. All the non-lichenised fungi in the National Herbarium of New South Wales (NSW) were transferred to DAR in the mid-1970s.

In addition to the herbaria listed above, two large culture collections deserve mention. The CSIRO Food Research Laboratory (FRR) at North Ryde has a very large culture collection of food spoilage organisms, especially *Penicillium*, on which genus J. I. Pitt is a leading world authority. Pitt is supported by Ailsa D. Hocking who curates the culture collection and also conducts research on the taxonomy of *Penicillium* and related genera. It is one of the most important collections of *Penicillium* and related genera in the world and contains isotype cultures of almost all *Penicillium* names. The collection is almost exclusively composed of living cultures, the few dried specimens mainly being lodged in DAR. The culture collection of the Department of Plant Pathology and Agricultural Entomology, University of Sydney contains over 3,000 isolates of *Fusarium*. Lester W. Burgess and students are involved with the ecology and taxonomy of this agriculturally important genus.

H. J. Swart, Botany School, University of Melbourne, has been an especially significant contributor to knowledge of fungi on leaves of native plants and is regarded as the outstanding mycological illustrator of recent decades. His series entitled 'Australian leaf-inhabiting fungi' in *Transactions of the British Mycological Society* consists of 29 papers (some still in press), describing many new species and genera and resolving a number of outstanding taxonomic and nomenclatural problems with Australian fungi. Swart retired in December 1987, and his specimens are in MELU.

Other taxonomists active between 1960 and the present include R. F. N. Langdon (Ustilaginales and Clavicipitales), D. G. Parbery (graminicolous *Phylla-*

chora spp.), P. H. B. Talbot (Aphylllopharales), G. Beaton (Discomycetes and hypogaeal Gasteromycetes), G. A. Kile (*Armillaria*), I. H. Parbery (Meliolales), J. E. C. Aberdeen (Agaricales), R. N. Hilton (Agaricales), C. J. Shepherd (Agaricales), J. H. Warcup (*Rhizoctonia* and related fungi), A. E. Wood (Agaricales) and D. H. Ellis (medical mycology). It can be seen that only a few of these have been involved with plant parasitic micro-fungi.

The neglect of fungal taxonomy

Currently active taxonomists (all groups) are listed by Australian Biological Resources Study (ABRS) (1987). An analysis of this list (excluding lichenologists and with some adjustment for recent retirements and deaths) yields a maximum of 15 Australian fungal taxonomists, although there are probably less than ten full-time professional taxonomists. If this is compared with ABRS figures for other groups of plants (Table III) the figures show a startling paucity of fungal taxonomy in this country. This, coupled with past neglect of mycology, means that our collective knowledge of Australian fungi lags far behind knowledge of other groups. Major groups of flowering plants, mosses, ferns and marine algae are almost completely known for the country. The disproportionate amount of taxonomic research being undertaken in some groups amounts to little more than fine tuning of classifications in which the majority of taxa are well known and clearly delineated.

The relative under-representation of fungal taxonomists would be understandable if fungi were either economically unimportant or numerically insignificant. They are patently not either of these! Fungi cause 90% of plant diseases and diseases cost Australian agriculture over \$2,000 million every year. And this does not include fungi involved in forestry, food spoilage, biodeterioration, mycotoxins, human and animal diseases, fungal poisoning, fermentation industries, drug production, and mycorrhizae. Of course if one shied away from economic criteria as a measure of the importance of plants one can still argue that fungi are of paramount ecological importance.

It is difficult to obtain estimates of the number of fungi but the following statistics should help to relate fungal numbers to vascular plant numbers. An Australian checklist on diseases of vegetable crops (Morschel 1975) lists 635 fungal diseases on 63 taxa of crop plants, plus 755 diseases not yet recorded in Australia. Note that the number of fungal taxa will be less

Table III
Numbers of plant taxonomists, extracted from Australian Biological Resources Study (1987), *Register of taxonomists and biogeographers*

	No. of taxonomists	Approx. no. of Australian spp.
All plants	358	25,000
Myrtaceae	57	1,500
<i>Eucalyptus</i>	25	600
Ferns	19	350
Algae	28	1,100*
Mosses	19	1,300
Lichens	11	2,300
Fungi (non-lichen)	15	c. 10 x plant spp.

* No. of benthic algae in southern Australia.

than the number of diseases since some fungi have broad host ranges. The *compendium of strawberry diseases* (Maas 1984) lists 50 fungal diseases on *Fragaria*, 50% of which are caused by fungal taxa unique to strawberry. The *Compendium of wheat diseases* (Wiese 1977) lists 36 fungi for *Triticum*, while the *Compendium of corn diseases* (Shurtleff 1980) lists 38 foliar and inflorescence fungi for *Zea mays*. Our recent work (Sutton & Pascoe, unpubl.) on fungi from Australian plants yielded 912 specimens in the first six months, comprising 268 plant taxa, from which we identified 514 fungal taxa. *Acacia* s. lat., of which we collected 71 species, yielded 94 fungal taxa, at least 45 of which are new to science. On the 13 species of *Banksia* collected from southeast Australia we identified 55 fungi from leaves alone. We know that our knowledge of *Banksia* fungi is more complete than for other genera because we find fewer new species now, but we are also aware that we have not looked at fungi from twigs, fruit, bark, litter, or wood or Western Australian species, and the ratio of fungal species to host species is already 4:1. So we have a range of ratios of fungal species to host species of from 25:1 in the case of strawberry, a completely studied host, to less than 2:1 for *Acacia*, on which we are still finding many new species, and this is without considering saprophytes, litter decomposers, endophytes, epiphytes, or mycorrhizae. It is hard to escape the conclusion that there are at least ten times as many fungi as vascular plants, and this means over 250,000 for Australia, of which we probably know fewer than 5%. There are fewer than 15 active fungal taxonomists which must be compared with 25 eucalypt taxonomists working on a group with only 600 species, and 19 fern taxonomists on a group with only about 350 species (ABRS 1987). So we are certainly not in a position where we could, group by group, complete the fungal volumes of *Flora of Australia* in the foreseeable future. We could probably write a handful of volumes, on groups such as the Uredinales and Ustilaginales, and Meliolales, but in many other groups so much remains to be done that we can scarcely be said to have begun.

What then are the reasons for this extraordinary neglect of the taxonomy of such a large and important group as the fungi? Why are there no mycologists employed by any herbaria associated with botanic gardens? Why do so few university Botany Departments teach fungal taxonomy? McAlpine (1895b) was also concerned about the neglect of mycology and made the following comments:

The reason for the fungi being so little known and comparatively neglected, in contrast to the higher divisions of the vegetable kingdom, are various. They are not as a rule, an attractive group, and the ordinary investigator passes them by. They are likewise somewhat difficult to determine, usually requiring the use of the microscope for that purpose. . .

He seems to have assessed the situation admirably. In terms of perceived attractiveness, fungi suffer from a kind of inverse 'cute and cuddly syndrome'. This is that syndrome that suggests that large, visible, attractive, benevolent organisms are more worthy of study than small, ugly, malevolent or technically demanding organisms. Likewise it is the syndrome that causes hordes of amateur naturalists to become bird watchers

or butterfly collectors, and that causes orchids to be the most eagerly embraced group in amateur botany circles. It is sad to think that this syndrome affects the setting of priorities in professional taxonomic research, but I believe it does. Since taxonomic research is seldom directed but occurs by individuals studying the groups to which they are most attracted, taxonomic endeavour is invariably dictated by conspicuousness, attractiveness and accessibility. Perhaps the direction being given to taxonomic research by ABRS will help correct this imbalance.

Macrofungi, although frequently conspicuous in the field, often discourage serious study because modern taxonomy is based largely on microscopic criteria and because of the lack of readily accessible literature on Australian species. Microfungi are often all but invisible in the field and are frequently collected on the basis of symptoms. Detailed laboratory study under dissecting and compound microscopes is necessary before the fungus can be seen and studied. Thus amateurs are frequently discouraged from mycology because they cannot afford microscopes, do not have the skill required for preparation of good microscope slides, or cultures, and find the literature too large and the terminology too complex. Other than the costs of microscopes, the same factors regrettably often militate against the involvement of plant pathologists and botanists in fungal taxonomy.

Taxonomic mycology has been the 'Cinderella' of botanical sciences in this country ever since Joseph Banks and his colleagues on Cook's voyage of discovery marvelled at the strange new plants and animals of Australia but failed to collect any fungi. Whether as a branch of botany or biology generally, mycology will continue to lag behind other disciplines as long as it remains almost exclusively the province of agricultural department plant pathologists and a few academics, whose other duties minimise the opportunity for research and often dictate a concentration on fungi of agricultural significance. University botany departments must reverse their declining support of taxonomic mycology, not only so that botanists can gain some awareness of mycology at the undergraduate level, but also so that more research into the taxonomy of non-economic fungi can be undertaken at a post-graduate level. However, I believe that the most urgent need is for herbaria associated with botanic gardens to appoint mycologists. Unless this need is recognized, and until the funding of mycological research becomes a priority outside of agriculture, there is very little hope that the fungi will ever be substantially represented in the *Flora of Australia*.

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